

CHAPTER ONE

Proper Operation

DRIVING A NEW CAR

A new car should not be driven faster than 20 miles an hour for the first 500 miles. If the car is run at top speed while new, the closely-fitted parts become overheated, resulting, perhaps, in scored pistons or sleeves, or burned bearings.

TO MAKE CAR READY

Fill radiator with clean, soft water.

Fill gasoline tank.

Fill oil reservoir through filler or breather pipe at left side of engine until oil indicator registers full. (See "Proper Lubrication," Page 11.) Supply all parts requiring lubrication with oil or grease.

TO START WITH ELECTRIC STARTER. FIG. 1.

Put gear shift lever in neutral and set hand brake.

Set throttle control lever one-third of the way up the quadrant.

Set spark control lever half way up.

Turn ignition key to "on" position.

Depress starter button in toeboard.

If engine fails to start at once close the choke tightly and open partly as soon as it begins to fire.

Set choke, spark and throttle controls at best operating positions as engine warms up. When engine is thoroughly warm, push choke all the way in. Do not run with choke out as this wastes gasoline and fouls the engine.

Never start engine with wide open throttle and fully advanced spark.

TO START ENGINE BY HAND. FIG. 1.

To operate the engine for the first time, or after the car has been standing for several weeks, start it with the hand crank which is included in the tool kit that accompanies the car.

Put gear shift lever in neutral and set hand brake.

Take out spark plugs and pour a quarter of a tea-cup of lubricating oil in each cylinder and turn engine over by hand ten or twelve times. Replace spark plugs.

Set throttle control lever one-quarter of the way up the quadrant.

Set spark control lever one-third of the way up the quadrant.

Pull out choke, shutting off air supply to cylinders.

Turn ignition key to "on" position.

Insert crank and pull up quickly in a clockwise motion until the engine fires. As soon as engine fires push choke in gradually until engine is warmed up. Then push choke all the way in.

Set spark and throttle control levers at best running positions.

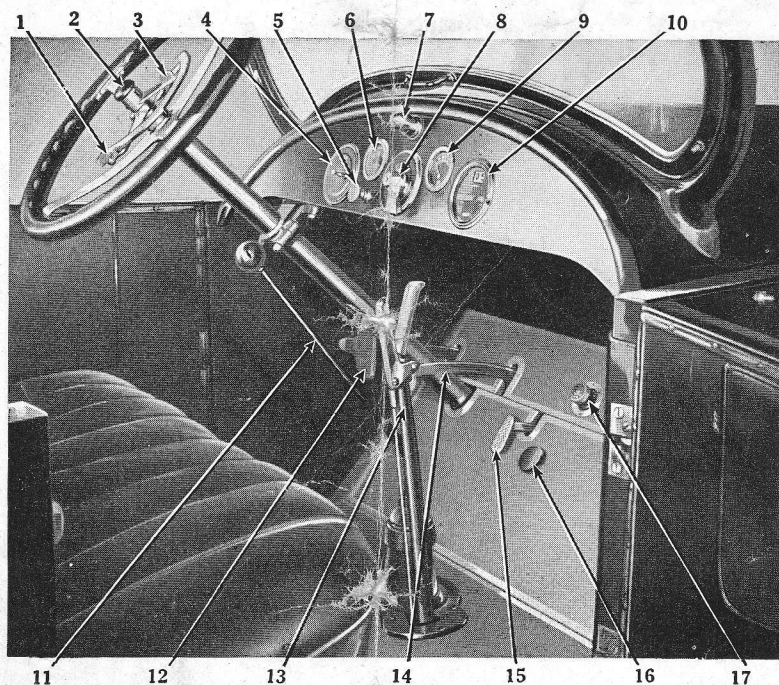


FIGURE 1—CONTROLS

- | | |
|-------------------------|-------------------------------|
| 1—Gas Throttle Lever | 10—Speedometer |
| 2—Horn | 11—Gear Shift Lever |
| 3—Spark Control Lever | 12—Clutch Pedal |
| 4—Fuses | 13—Brake Lever |
| 5—Choke | 14—Brake Pedal |
| 6—Oil Pressure Gauge | 15—Accelerator |
| 7—Dash Lamp | 16—Accelerator Pedal Toe Rest |
| 8—Ignition-Light Switch | 17—Starter Button |
| 9—Ammeter | |

TO START CAR

Release hand brake, if set.

Depress clutch pedal.

Move gear shift lever to first speed position.

Depress foot accelerator pedal gradually and at the same time slowly release clutch pedal.

Allow car to gain momentum, then release accelerator and depress clutch pedal at the same moment.

Shift gear lever rapidly to second speed position.

Depress foot accelerator pedal gradually and at the same time slowly release clutch pedal.

Shift to third or "high" speed in the same way, releasing accelerator and depressing clutch pedal before shifting lever.

It is recommended that the speed of the car be controlled by the foot accelerator, not only in shifting gears but in driving.

TO CHANGE TO LOWER SPEED. FIG. 1.

Depress clutch pedal.

Speed up engine slightly, if traveling on level road.

Move gear shift lever quickly into next lower speed and release clutch pedal.

It will be found advisable to make this change when the engine is placed under a heavy pull, or when dropping down to very slow speed, as when traveling up a steep grade, in sand, or in congested traffic.

Never attempt to make the change with the car traveling at a high rate of speed.

TO STOP THE CAR. FIG. 1.

Close throttle.

Depress clutch pedal.

Apply foot brake.

With car at standstill, move gear shift lever into neutral.

Set hand brake.

Release clutch pedal.

TO REVERSE CAR. FIG. 1.

With car at a *standstill*, depress clutch pedal.

Shift gear lever into reverse position.

Slowly release clutch pedal.

TO STOP ENGINE. FIG. 1.

Switch off ignition.

USE OF SPARK CONTROL LEVER. FIG. 1.

The position of the spark lever should vary with the speed of the engine. For the driver operating his first car, it simplifies driving to leave the lever in one position, about two-thirds of the way up the quadrant, or as far as it can be advanced without the engine developing a knock.

When the car is throttled to its lowest speed on high gear the spark should be retarded until the car runs smoothly. If advanced too far a sharp metallic click will be heard in the engine and the spark should be retarded as the bearings will be damaged by having the spark occur too early. When the engine is idling the spark lever should not be advanced more than one-half of the way up the quadrant.

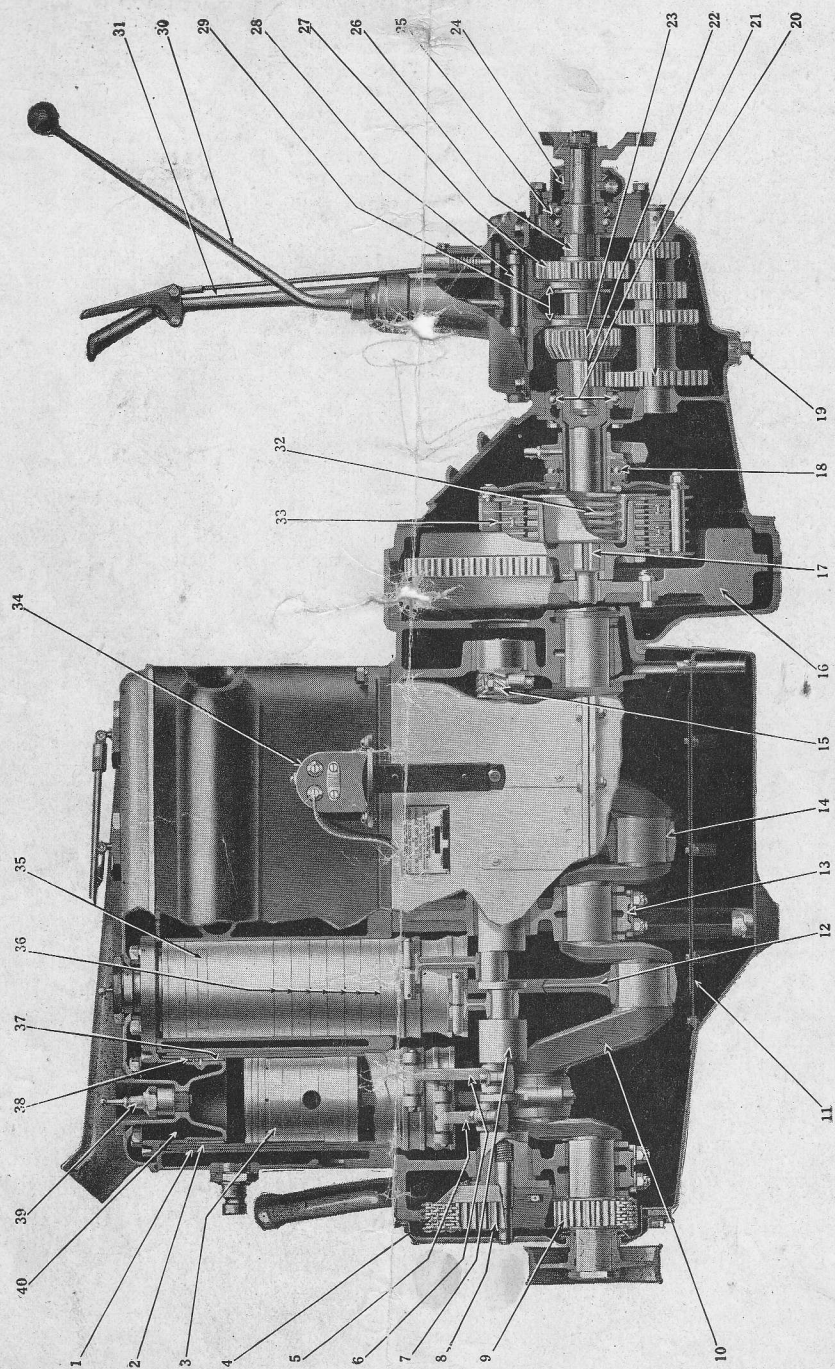


FIG. 2—CROSS SECTION OF ENGINE, CLUTCH AND TRANSMISSION

KEY TO FIG. 2, ON OPPOSITE PAGE

- | | |
|----------------------------------|---|
| 1—Outer Sleeve | 21—Front Annular Bearings |
| 2—Inner Sleeve | 22—Main Drive Gear |
| 3—Piston | 23—Direct and Second Speed Sliding Gear |
| 4—Silent Drive Chain | 24—Speedometer Gear |
| 5—Inner Sleeve Connecting Rod | 25—Rear Annular Bearing |
| 6—Outer Sleeve Connecting Rod | 26—Transmission Main Shaft |
| 7—Eccentric Shaft | 27—Reverse and First Speed Sliding Gear |
| 8—Eccentric Shaft Sprocket | 28—Transmission Shifter Shaft |
| 9—Crankshaft Sprocket | 29—Shifter Forks |
| 10—Crankshaft | 30—Gear Shift Lever |
| 11—Crankcase Oil Level | 31—Inner or Emergency Brake Lever |
| 12—Piston Connecting Rod | 32—Clutch Coil Spring |
| 13—Crankshaft Bearing | 33—Clutch Discs |
| 14—Piston Connecting Rod Bearing | 34—Ignition Coil |
| 15—Oil Pump Driving Gears | 35—Exhaust Port in Sleeve |
| 16—Flywheel | 36—Sleeve Oiling Grooves |
| 17—Clutch Shaft | 37—Compression Ring |
| 18—Clutch Thrust Bearing | 38—Oil Ring |
| 19—Transmission Case Drain Plug | 39—Spark Plug |
| 20—Countershaft Gears | 40—Water Jacket in Cylinder Head |

CHAPTER TWO

Proper Lubrication

ENGINE LUBRICATION

All parts of the Willys-Knight engine are oiled from one big oil reservoir in the crank case. Oil is fed from the main line to the crank shaft bearings, to the connecting rod bearings and to the eccentric shaft bearings by pressure supplied by an oil pump located in the rear of the engine; and to the pistons, piston rings, wrist pins and sleeves by the spray thrown off the rod bearings.

The lubricating system is designed to supply the greatest amount of oil when the engine is doing its greatest work, *i. e.*, when accelerating, climbing hills, pulling through mud, snow, sand, etc. This is accomplished by regulating the oil pressure, not by the car speed, but by the throttle opening. Interconnecting the oil control valve with the throttle, oil pressure is supplied exactly as the engine needs it. As the throttle is opened, the pressure is increased.

The capacity of the oil system is one and one-quarter gallons. Care should be taken to replenish the supply before the wire indicator located at the left side of the engine has descended to its lowest point.

Fresh oil should be poured into the reservoir through the combination filler and breather pipe, first removing the cover. The location of this pipe is indicated by "1" in Fig. 8.

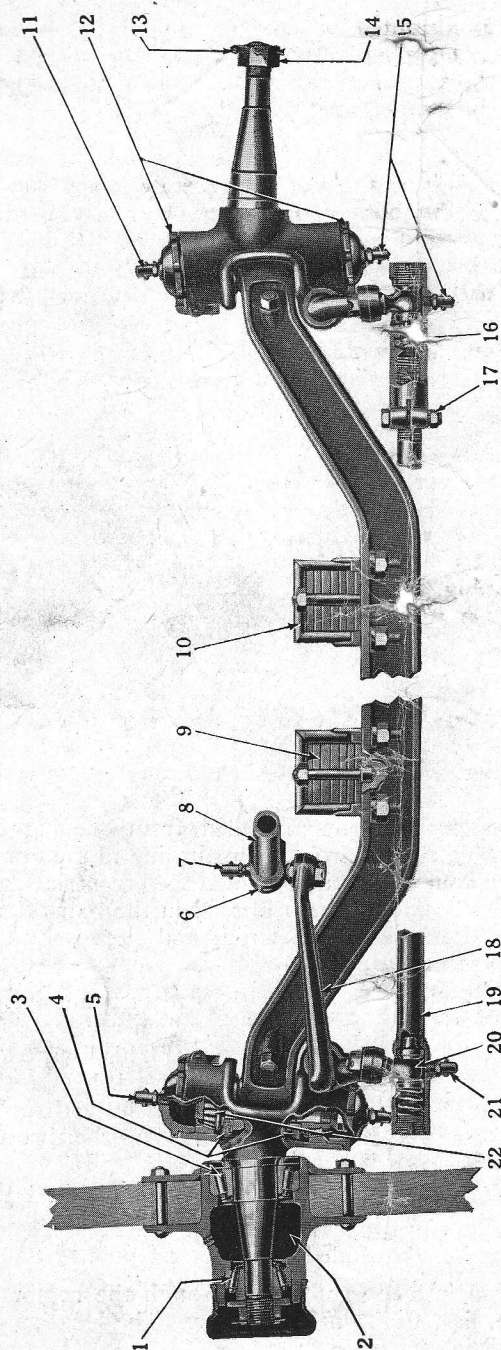


FIG. 3.—FRONT AXLE ASSEMBLY

- | | |
|---|----------------------------------|
| 1—Outer Taper Roller Bearings | 12—Bearing Adjusting Caps |
| 2—Keep This Space Well Packed with Grease | 13—Spindle Nut Cotter Pin |
| 3—Inner Taper Roller Bearings | 14—Spindle Nut |
| 4—Steering Knuckle Taper Roller Bearings | 15—Grease Cup |
| 5—Grease Cup | 16—Ball Seat Spring |
| 6—Steering Knuckle Connecting Rod Ball | 17—Adjustable Ball Joint |
| 7—Grease Cup | 18—Steering Arm |
| 8—Steering Gear Connecting Rod | 19—Steering Knuckle Tie Rod |
| 9—Spring Leaves | 20—Steering Knuckle Tie Rod Ball |
| 10—Spring Clip | 21—Grease Cup |
| 11—Grease Cup | |

PRESSURE GAUGE. FIG. 1.

The oil pressure gauge is mounted on the instrument board, and indicates the pressure being supplied. Any failure of the gauge to register indicates either an absence of oil, an obstruction in the oil line, or an air leak, and should be investigated immediately.

TO DRAIN CRANK CASE

After first 300 miles and every 500 miles—completely drain the oil by opening the drain plug in the bottom of the crank case and refill with fresh lubricant, using a good medium-weight engine oil in cold weather and a heavy oil in hot weather. The very best oils will be found more economical, as their use insures longer life to the bearings and moving parts.

There also may be occasions, particularly in colder weather, when it will be found advisable to replace the lubricant oftener than once every 500 miles.

TO CLEAN OIL STRAINER. FIG. 5.

After the first 500 miles of running and every 1,000 miles thereafter it is recommended that the mesh oil strainer, assembled with the oil pump in the crank case, be removed and cleaned, as sediment will collect on it and partially obstruct flow of the lubricant. To remove this strainer, unscrew the drain plug, take out two screws in strainer cover and take out strainer. Wash it thoroughly in kerosene or gasolene and replace.

OILERS

All oilers, indicated by "O," in Fig. 8, should be gone over with the compressor, which is furnished with the tool kit, once every week, or 250 miles. Hook the bayonet coupling at the end of the flexible steel hose of the compressor to the nipple of the oiler. This is best done by placing the coupling over the nipple with the steel projector opposite the coupling slot, and by a slight pressure forward and a turn to the right an absolutely tight joint is made. Turn handle to right until grease is forced through the bearing. Before disconnecting coupling turn handle back to relieve pressure so that the grease will not flow from the coupling when disconnected. If you do not seem to be able to force grease to the bearing surface, it may be because the bearing oil leads have become clogged and caked with old grease and no amount of pressure will dislodge it. In such cases it is advisable to take the bearing apart and clean it.

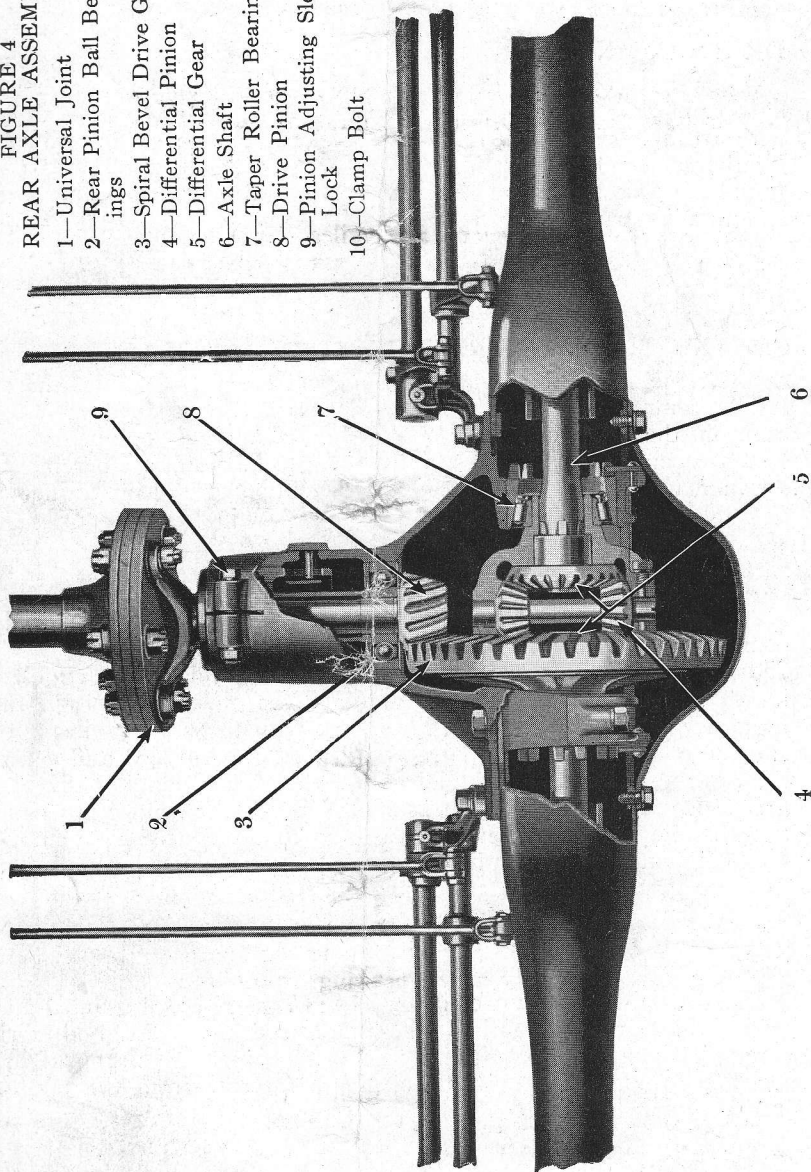
Use a semi-fluid steam cylinder oil, such as it recommended for the transmission and differential. The importance of using a good lubricant cannot be exaggerated, as the cost will be more than repaid by the freedom from rattles and squeaks which result from the use of an inferior quality of oil.

GENERATOR OIL CUP

Each week—or every 250 miles—pour seven or eight drops of engine oil in the oil hole, at front end of the generator, indicated by "4" in Fig 8.

FIGURE 4
REAR AXLE ASSEMBLY

- 1—Universal Joint
- 2—Rear Pinion Ball Bearings
- 3—Spiral Bevel Drive Gear
- 4—Differential Pinion
- 5—Differential Gear
- 6—Axle Shaft
- 7—Taper Roller Bearings
- 8—Drive Pinion
- 9—Pinion Adjusting Sleeve Lock
- 10—Clamp Bolt



TIMER

The oil cup on the timer, indicated by "5" in Fig. 8 and also shown in Fig. 9, should be lubricated once a week—or every 250 miles—with a light oil, as lubrication of this unit insures accurate and even distribution of electrical current to the spark plugs.

STARTING MOTOR

Every two weeks—or every 500 miles—pour seven or eight drops of engine oil in the oil filler hole at the rear end of the starting motor indicated by "6" in Fig. 8, and also shown in Fig. 11.

CLUTCH

Every two weeks—or every ~~500~~ miles—lubricate the clutch. Turn back screws on steel clutch cover, exposing lubricator to view, at point indicated by "7" in Figure 8. Attach coupling of compressor and lubricate. A few drops of oil applied to the pins on which discs slide will also prevent squeaking. The discs do not require lubrication.

TRANSMISSION

Every three months—or every 3,000 miles—drain the oil from the transmission case by unscrewing the drain plug in the bottom of the case. Then replace the plug and pour in a semi-fluid steam cylinder oil through the filler hole at the right side of the housing, as indicated by "2" in Fig. 8, until the oil is level with the oil hole.

DIFFERENTIAL

Every three months—or every 3,000 miles—pour in a semi-fluid steam cylinder oil through the oil level plug in the rear cover, shown by "3" in Fig. 8, until the oil is level with the oil hole, and replace plug. Do not fill above level or oil may run out at wheel ends. Once a season drain the oil in the rear system by unscrewing the drain plug in the bottom of the differential housing; draw off the old lubricant and refill.

WHEEL BEARINGS

Once a season remove the wheels and repack the bearings on all wheels with a good grade of medium weight cup grease. Spread grease with a paddle upon the cage holding the rollers. Also fill the hub. Any seeming excess will be taken up by the parts as soon as they begin to operate. Make sure there is no grit on the paddle. Should you find grit in the bearings, wash the bearings thoroughly with gasolene or kerosene and dry them. Then lubricate bearings and hub.

HORN

Once a month—or every 1,000 miles—remove the cover in rear of horn and pour a few drops of light oil in the oil hole of the horn motor to lubricate the armature shaft.

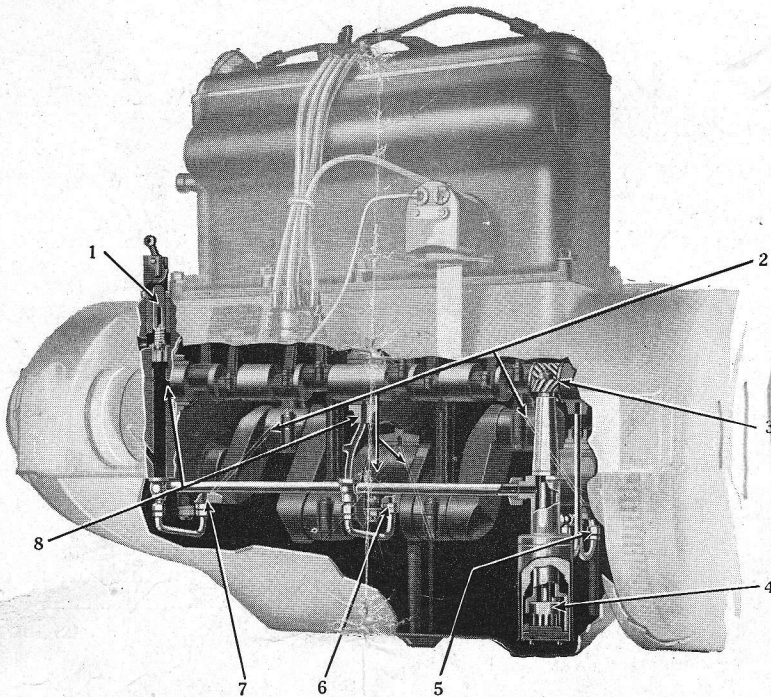


FIG. 5—ENGINE LUBRICATING SYSTEM

- 1—Oil Control
- 2—Drilled Leads in Crankshaft
- 3—Oil Pump Drive Gears
- 4—Oil Pump Gears
- 5—Leads to Rear Main and Eccentric Shaft Bearings
- 6—Lead to Center Main Bearing
- 7—Lead to Front Main Bearing
- 8—Leads to Front and Center Eccentric Shaft Bearings

CHAPTER THREE

Proper Maintenance**NEVER RUN ENGINE IN CLOSED GARAGE**

Due to the presence of carbon monoxide (a poisonous gas in the exhaust of the engine) never run the engine for any length of time while the car is in a small, closed garage. Opening the doors and windows will lessen the danger considerably, but it is safest, if adjustments are being made that require operation of engine, to run the car out of doors.

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TO CLEAN RADIATOR

Should it become necessary to clean the radiator, dissolve a half pound of lye in about five gallons of water. Strain the liquid through a cloth and put in the radiator. Run the engine for five minutes, then draw off the cleaning mixture. Fill with clean water and run the engine again; remove the liquid and finally refill the cooling system. Avoid the use of more powerful chemicals.

TO CLEAN MUD OFF RADIATOR

If the air spaces of the radiator become clogged with mud, do not attempt to remove the mud with a screw driver, wire or other metal instrument. Instead, soften the mud with water. The best way to wash the radiator is to flush a stream of water from a hose through it from the rear. In doing this, take care not to let any water get into the spark coil, as it is apt to short circuit the ignition.

TO DRAIN RADIATOR

Open the drain cock under the radiator about once a month and let out all the water and accumulated dirt. An effective way of cleaning is to remove the drain cock reducer-bushing into which the cock is screwed and to keep on filling the radiator while the water continues flowing out below; when the water begins to look clear replace the reducer-bushing, close the drain cock and fill to the top. The capacity of the cooling system is 5 gallons.

FAN BELT ADJUSTMENT

Occasionally it will be found necessary to take up the slack in the fan belt. This can be done by loosening the clamp bolt on the fan bracket, then turn the eccentric on the fan shaft until belt is drawn tight and tighten clamp bolt.

TO ADJUST CARBURETOR (for idling and low speed only). FIG. 6.

Changes in carburetor adjustment should only be made for the varying seasons, as a slightly leaner mixture of gasoline with the air is required for summer than for winter driving in temperate regions.

To adjust the carburetor, set the choke valve in full open position, after running the engine until it is warm. Retard the engine to a driving speed of approximately 15 miles per hour and advance the spark lever about half way up on the quadrant. Slowly close the needle valve, by turning to right, cutting down the amount of gasoline, until the engine starts to miss because of too lean a mixture. Then open the needle valve slightly so that the engine begins to fire regularly. If the engine still lacks power, turn valve still further to the left, giving additional fuel. Now retard throttle lever to its lowest operating point. Should the engine run too fast or stop, correct it by setting the stop screw on the carburetor throttle lever until engine idles properly.

Adjustments can be made for idling and low speeds only, as the carburetor is designed and constructed automatically to take care of fuel requirements for the higher speeds of the engine.

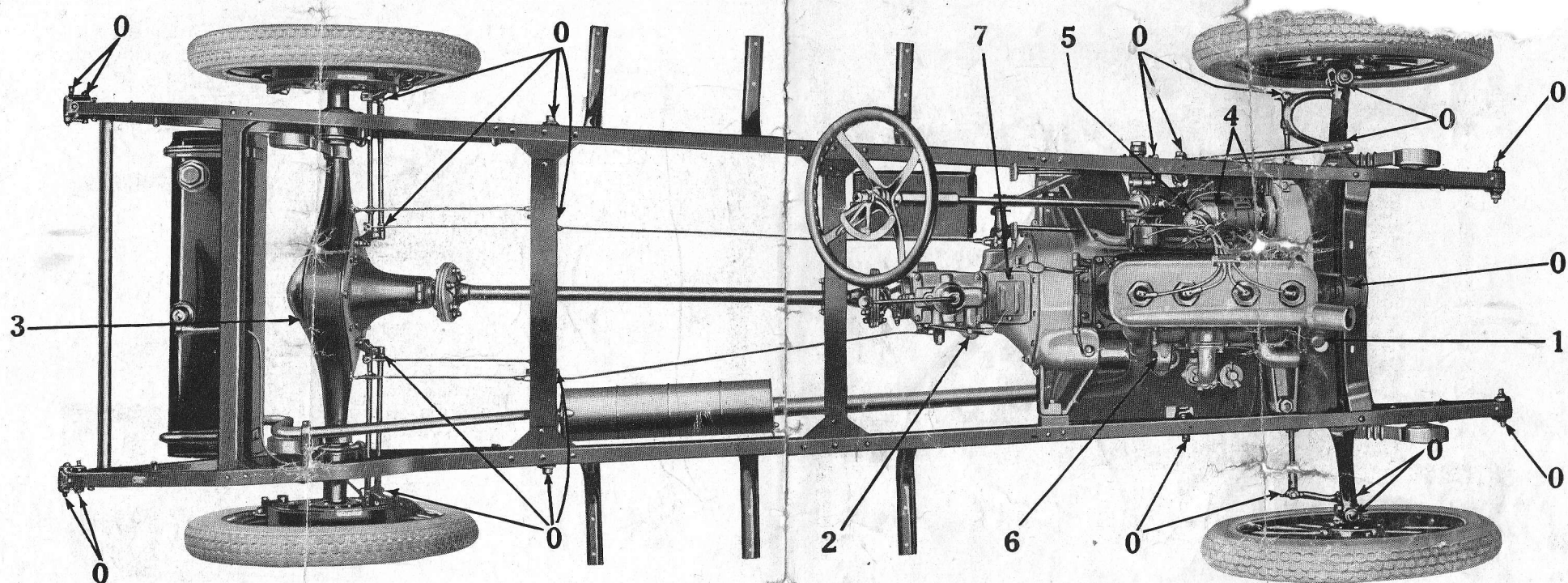


FIG. 8—CHASSIS, SHOWING POINTS REQUIRING LUBRICATION

0—Lubricate oilers every 250 miles with compressor furnished in tool kit, using semi-fluid steam cylinder oil—prevents excessive wear, rattles and squeaks.

1—Refill engine with fresh oil every 1,000 miles—prevents scored pistons and sleeves, burned bearings and other damage that would necessitate costly repairs.

2—Draw off old lubricant and refill transmission with fresh semi-fluid steam cylinder oil every 3,000 miles—prevents excessive wear of transmission gears and bearings.

3—Refill differential with fresh semi-fluid steam cylinder oil every 3,000 miles—prevents excessive wear of differential pinions, gears and bearings.

4—Oil generator every 250 miles—prevents wear of ball bearings.

5—Lubricate timer every 250 miles—this insures accurate and even distribution of electrical current to the spark plugs.

6—Pour seven or eight drops of engine oil in oil filler hole of starting motor every 500 miles—keeps drive end bearings well lubricated.

7—Lubricate clutch release bearing oiler every 500 miles with compressor—prevents excessive wear. Also drop a little oil on pins on which disc slide to prevent squeaking.

Occasionally drop a little oil on the joints and clevises throughout chassis. Pour a few drops of light oil in oil hole of horn motor every 1,000 miles. Once a season repack wheel bearings and snubbers with fresh cup grease.

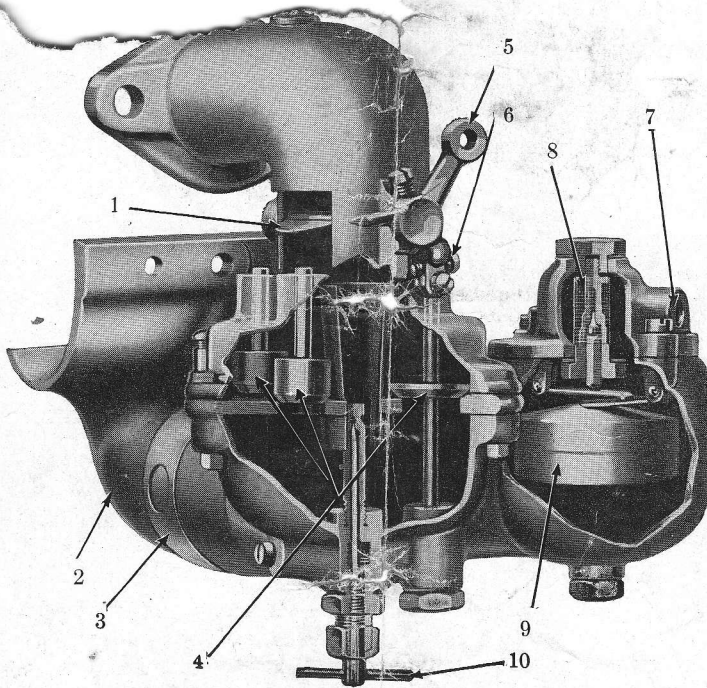


FIG. 6—CARBURETOR

- 1—Gas Throttle
- 2—Air Horn
- 3—Air Shutter
- 4—Automatic Air Weights
- 5—Throttle Lever

- 6—Throttle Lever Stop Screw
- 7—Inlet from Tank
- 8—Strainer
- 9—Carburetor Float
- 10—Needle Valve Adjusting Screw

TO CLEAN CARBURETOR MESH STRAINER

Occasionally sediment clogs the mesh strainer in the carburetor, preventing the flow of fuel to the cylinders. To clean this strainer unscrew the drain plug at the top of the float bowl, then remove the strainer and wash with kerosene or gasolene.

GASOLENE SUPPLY TANK

When filling, care should be exercised that no foreign matter enters the gasolene tank. About once a month, especially at a time when the gasolene supply is low, it is advisable to clean the mesh strainer in the bottom of the fuel tank in the rear of the car. To clean the strainer, unscrew the drain plug in the bottom of the tank; the strainer is attached to the plug. Wash the strainer with kerosene or gasolene and replace.

Frequently inspect the vent hole in the filling cap to see that it is not clogged, otherwise vacuum tank will fail to work.

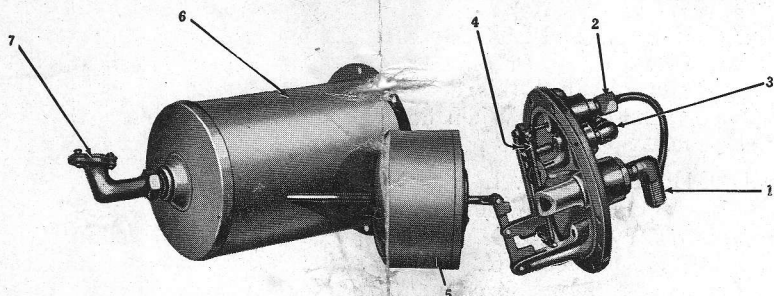


FIG. 7—VACUUM TANK

- | | |
|---------------------------------|------------------|
| 1—Gasolene Line from Tank | 5—Float |
| 2—Air Vent to Vacuum Chamber | 6—Vacuum Chamber |
| 3—Vacuum Line to Manifold | 7—Flapper Valve |
| 4—Toggle Lever Operating Valves | |

VACUUM TANK. FIG. 7.

Failure of gasolene supply may be traced to dirty or improperly operating valves in vacuum tank. If gasolene supply fails after filling gasolene tank, close throttle, turn engine over with starter which will fill vacuum tank. Vacuum tank can also be filled by removing the small pipe plug on top and pouring in sufficient fuel. Occasionally clean mesh strainer assembled in gasolene line from supply tank.

CARE OF TIMER CONTACT POINTS. FIG. 9.

The timer contact points should be kept smooth and clean as dirt will cause them to become pitted and burned. They can be kept clean with a small platinum or nail file. Should they be replaced, contact points should be adjusted by the small screw which holds the stationary contact point in place. When making adjustment be sure that the fibre roller is at the highest point of cam. With roller in place, loosen the lock nut and turn contact screw until the opening between the contact surfaces is .018 of an inch in width. The timer assembly, as shown in Fig. 9, is exposed by removing the distributor cover which is held in place by spring clamps, and distributor disc.

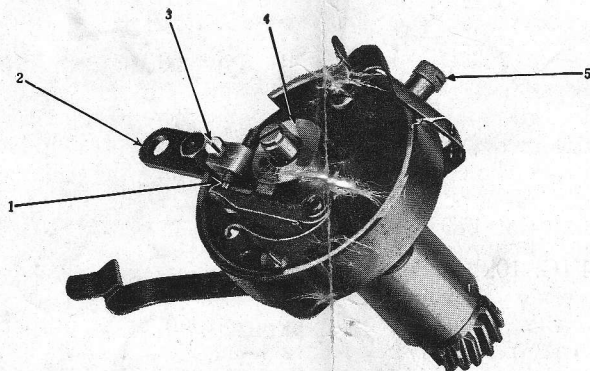


FIG. 9—TIMER

- | | |
|-----------------------|----------------------------------|
| 1—Distributor Arm | 3—Contact Points Adjusting Screw |
| 2—Spark Control Lever | 4—Cam |
| | 5—Oil Cup |

TO CLEAN SPARK PLUGS. FIG. 2.

An excess of oil or oil of poor quality will short-circuit the spark plug points. When this occurs clean them with an old tooth brush dipped in kerosene. When badly fouled, soak the plugs over night in kerosene. Spark plug points should be set .025 of an inch apart.

SPEEDOMETER. FIG. 1.

Do not permit a jeweler or garage man to repair a speedometer head as it is utterly impossible without special calibrating machinery to make the instrument accurate. If trouble is experienced with the speedometer consult the speedometer maker's nearest branch or service station.

AMMETER. FIG. 1.

This instrument, located on the instrument board, indicates the amount of electrical energy being consumed by the ignition lights or horn, or the amount of charge by the generator. It requires no care other than to keep the terminals tight.

CARE OF HORN

The commutator of the horn should be cleaned occasionally in order to preserve the quality of its tone and to prolong the life of the horn. To clean, take off horn motor cover, and press button on top of steering wheel to set motor in motion. Then moisten a cloth that is free from lint in light oil and hold commutator until clean.

The tone of the horn may be varied by loosening the lock nut in rear of the horn motor and moving the adjusting screw forward or backward until the desired tone is reached. Turning screw to the left loosens the adjustment and gives a higher pitch; turning to the right tightens the adjustment and gives a lower pitch. Never adjust screw too tightly; it should always be possible to turn the armature with the fingers.

If horn does not operate and oiling and cleaning do not correct the trouble, examine wiring, battery and push button on steering wheel. If no trouble is apparent, send or take the horn to the service station for the necessary repairs.

TO ADJUST CLUTCH

The clutch is of the multiple disc type with asbestos facings. It is fully encased in the flywheel. The only care necessary is to adjust the pedal to allow for the natural wear of the clutch facings. Adjustment is obtained by means of the set screw in the clutch release dog. This adjustment merely changes the position of the pedal at the moment of release. The pedal should move about one inch from the fully engaged position before it begins to release.

BRAKES. FIG. 10.

There is no part of the car that should receive more careful attention than the brakes, as their failure to operate properly at critical moments may result in serious accidents.

The foot brake should be used for all normal braking purposes. The hand brake should be used only in cases of extreme need to assist the foot brake, or to hold the car when it is left standing.

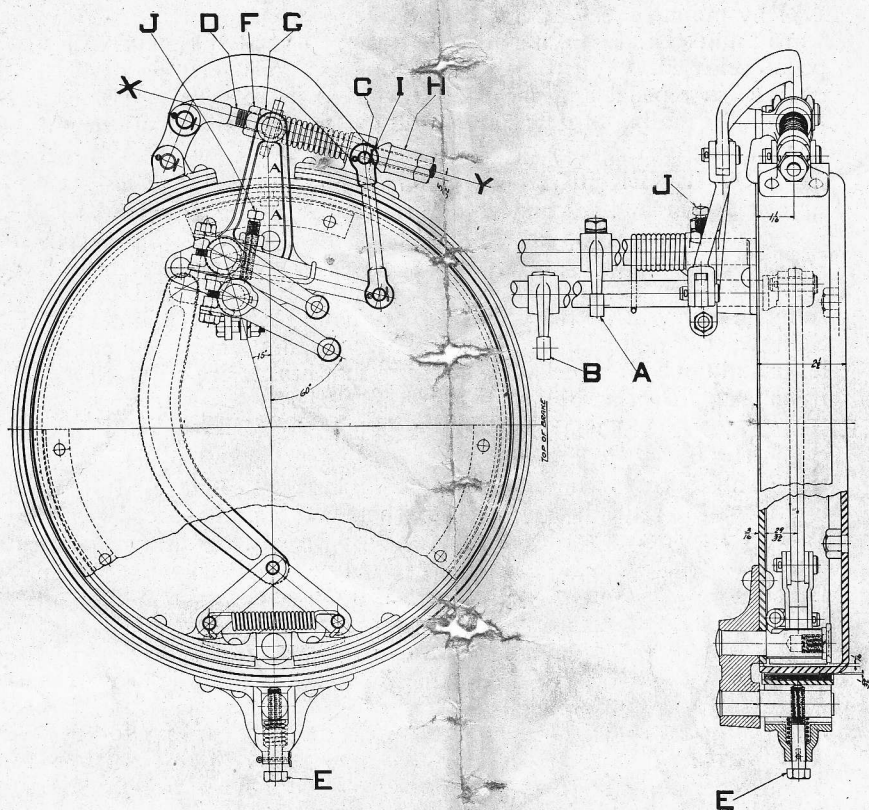


FIG. 10—BRAKE ASSEMBLY

TO ADJUST FOOT BRAKES

Should outer brakes require adjustment it is due to one of two reasons, either the brakes when released do not have sufficient clearance between drum and lining or else the clearance between these points is too great.

To adjust brakes, jack up so that both wheels are free from ground; disconnect brake pull rods so that levers (A), shown in Fig. 10, are in their natural position. Adjust set screw (J) so that eye of operating lever at (C) is in its correct position with reference to center line of adjusting rod (D). Lock (J) with jam nut and make sure that end of set screw rests against clamped collar. Adjust screw (E) to get $\frac{1}{2}$ of an inch clearance between drum and lining.

Proceed then with lower half of brake. Release jam nut (F) and stop nut (G) up or down as condition requires to obtain $\frac{1}{2}$ of an inch clearance. Then adjust lower half as upper half was adjusted. After both halves have been adjusted to the $\frac{1}{2}$ of an inch clearance, lock jam nut (F) against stop nut (G).

Adjust rear pull rods so that with intermediate rocker shaft levers pulled back as far as possible, yoke end pins can be inserted in levers

(A) by pulling these levers forward $\frac{1}{32}$ to $\frac{1}{16}$ of an inch. Adjust forward pull rod so that pin stands midway in slotted yoke end, with brake pedal released. When these adjustments have been properly made, operate foot pedal and try both wheels to make sure that brakes are adjusted equally, otherwise equalize these by manipulating nuts F, G and H.

TO ADJUST INNER BRAKES. FIG. 10.

Jack up car and disconnect pull rods. Adjust rear pull rods so that with intermediate rocker shaft levers pulled back as far as possible yoke end pins can be inserted in levers (B) by pulling these levers forward $\frac{1}{32}$ to $\frac{1}{16}$ of an inch. Adjust forward pull rod so that pin stands midway in slotted yoke end with hand brake lever in off position. Spin wheels to make sure that brakes do not drag. Operate hand lever and try both wheels to make sure that brakes are adjusted equally; if not, equalize them by adjusting pull rods.

KEEP GREASE AND OIL OFF BRAKES

The brake bands must be kept free from oil and grease. Should these substances accumulate they will glaze the surface of the brake lining, causing the brakes to slip whenever braking effort is applied. When this prevails wash lining with kerosene to restore it to its normal condition.

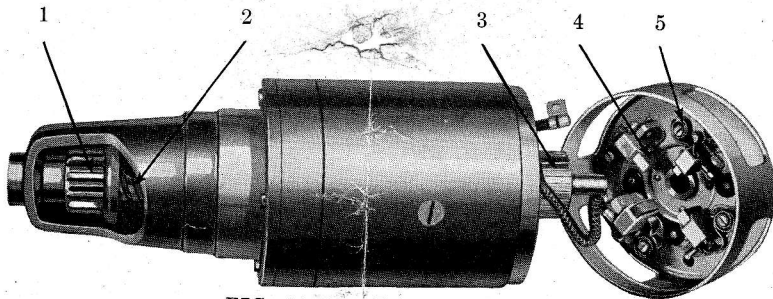


FIG. 11—STARTING MOTOR

1—Threaded Sleeve Shaft
2—Pinion

3—Commutator 4—Brush
5—Brush Hold-Down Spring

CARE OF STORAGE BATTERY. FIG. 12.

Neglect or abuse will shorten the normal life of a battery.

Care of the battery in service can be summed up best in the following rules:

1. Keep plates in each cell covered by adding pure distilled water when necessary.
2. Take frequent hydrometer readings in order to determine that the specific gravity of the electrolyte in each cell is correct.
3. Should the hydrometer show that the gravity has fallen in the cells, then operate the car, using the lights and electric starter sparingly, until the battery can be recharged. If this is not convenient, have the battery recharged at the nearest USL battery service station.
4. Keep filling plugs tight and the top of the battery clean.
5. Keep all battery connections tight and the top of battery clean.
6. Keep battery connections coated with vaseline to prevent corrosion.

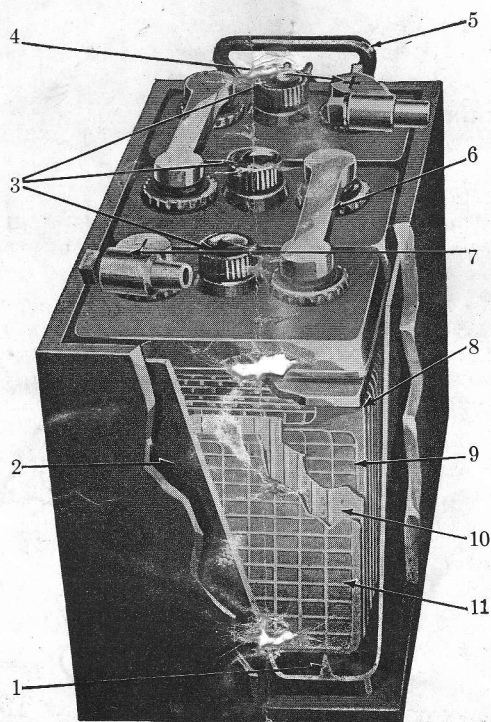


FIG. 12—BATTERY

- | | | | |
|--------------|---------------------|---------------------|-------------------|
| 1—Bridge | 4—Positive Terminal | 7—Negative Terminal | 10—Separator |
| 2—Rubber Jar | 5—Handle | 8—Electrolyte Level | 11—Negative Plate |
| 3—Vents | 6—Connecting Link | 9—Positive Plate | |

TO ADD WATER

If the plates are exposed for any length of time they can be seriously damaged, therefore it is advisable to add water enough to keep the plates covered. In this respect the battery will require more attention in summer than in winter. In freezing weather, when it becomes necessary to add water, always do it just before running the car. Water being lighter than the electrolyte, will remain on the surface and will freeze if the temperature is low enough. If the engine is run immediately after, however, the effect of the charging current will be to mix thoroughly the water and the electrolyte. The electrolyte in a fully charged battery, with a specific gravity of 1.285 will freeze only at 85 degrees Fahrenheit below zero.

To add water remove filling plugs, and if level of electrolyte is found to be less than $\frac{5}{8}$ of an inch above the plates, add only pure, distilled water or clear rain water that has not come into contact with metal or cement containers, until the proper level is reached. Be sure to screw caps securely on vent holes.

Nothing but water should be used in the cells. If acid of any kind, alcohol, or, in fact, anything but pure water is added to the cells, it may result in very serious injury to the plates.

HYDROMETER READINGS

The hydrometer is an instrument used for quickly detecting the specific gravity of the contents of the cells. A reading of 1.285 to 1.300 indicates that the battery is fully charged. A reading of 1.225 indicates that the battery is about one-half charged. The gravity below 1.200 indicates that the cells are near exhaustion. It is advisable to take hydrometer readings after the car has been run for some little time and before water is added to the battery. Should the gravity register below 1.225 it will be necessary to use lights and starter very sparingly until the battery has had an opportunity to build itself up again.

It is well to make it a practice to have your nearest USL Battery Service Station frequently inspect the battery. You will find them willing to co-operate with you towards seeing that your battery is at all times maintained in perfect condition, thus keeping down your cost of battery upkeep.

IF GENERATOR DOES NOT GENERATE. FIG. 13.

Make sure that all connections are clean and tight. See that commutator is clean. See that the brushes make perfect contact and that there is no sparking. See that all nuts and screws are tight.

SHORT-CIRCUIT GENERATOR WITH BATTERY REMOVED

If the battery has been removed from the car do not run the engine unless the generator has been short-circuited. This can best be done by connecting the terminal on the generator to any part of the engine with a piece of bare copper wire. Be sure that the wire is removed when the storage battery is put back on the car. If you wish to run the car with battery removed, short-circuit the generator, then connect three dry cells in the battery circuit. This will give you current for ignition, but care must be taken not to use starter or lights.

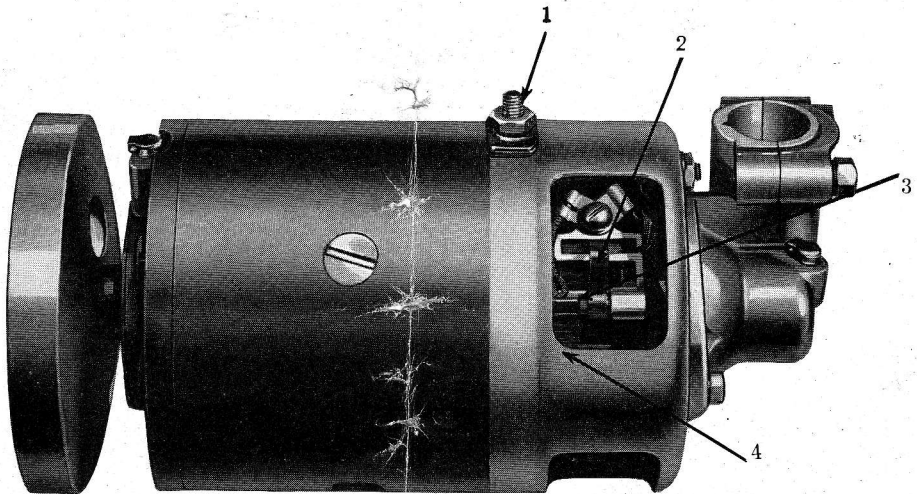


FIG. 13—GENERATOR

1—To Battery
2—Brush

3—Brush Hold-Down Spring
4—Commutator

INSPECTION OF WIRING. FIG. 14.

All electrical wiring should be carefully inspected every few thousand miles to make sure that all terminal connections are tight and that the insulation has not been chafed or rubbed off to cause a short circuit. Terminals are likely to work loose and should be tightened occasionally.

BODY

Do not keep your car where it is exposed to stable fumes and ammonia, or the varnish will become dull. Wash mud off promptly, especially when the car is new, as a new car spots more quickly than an old one. Do not scrape mud off—rinse with water until mud drops off. Chassis and wheels can be washed with warm water and castile soap, applying it with a soft sponge until grease and dirt are removed. Then rinse thoroughly with clean water and dry with chamois. Do not let soap dry as this causes streaks and spots.

Never wash the hood of the car when hot.

Inspect all body bolts every 1,000 miles of travel and tighten all loose nuts.

SPRINGS

It is good policy to lubricate spring shackle bolts freely. Examine spring clips which hold springs to front and rear axles. Tighten these nuts periodically as loose clips can cause spring breakage.

CARE OF TOP

The top should be frequently dusted and brushed off. Gasolene and kerosene should never be used to clean it. Grease can be removed with soap and water. The inside, or cloth side, of the top should be dusted with a whisk broom or stiff brush.

Do not fold the top while it is wet or damp, unless it can be raised within a short time and thoroughly dried out. If folded while moist it will become mildewed.

When laying back the top be careful not to allow the back curtain to sag so that the plate glass windows strike against the tire on the carrier in the rear of the car. As soon as the top is put back attach the strip along the lower edge of the windows to the fasteners on the back of the rear seat.

CARE OF UPHOLSTERY

Never use gasolene to clean leather upholstery. Water, with a little ammonia added, will remove any grease spots, and this attention, except an occasional dusting, is all that the upholstery will require. The leather can be polished with a clean cloth.

NICKEL TRIMMINGS

To preserve the polish of nickel trimmings wipe them off with a clean cloth. Never use metal polish as this will destroy the lustré of any highly polished surface. If the car is to be stored for any length of time these surfaces should be rubbed with an oiled cloth to prevent tarnishing.

TO CLEAN AND POLISH HEAD LAMP REFLECTORS

To clean the reflectors of the lamp wipe them off with a small ball of absorbent cotton that has been dipped in alcohol, after blowing them out with air hose or bellows. The best way to polish them is to first sponge them off lightly with a soft, wet cloth so as to remove all loose

dirt. When dry, take a piece of dampened chamois and dip it in jeweler's rouge and then polish the reflector. Always wipe the reflector with a motion from the bulb directly to the rim of the reflector. Never use metal polish on the reflector. These reflectors are silver plated and can be spoiled by too frequent polishing.

TO REDUCE TIRE EXPENSE

The satisfaction that you get from your tires is directly dependent upon the attention you give them. To get the most service at least expense, inspect the tires frequently; seal or repair all small holes and cuts with tire putty, preventing water and dirt from working between the fabric and rubber tread.

Never run on a tire that is partly deflated as this causes rim cutting. The chances of a puncture are greatly reduced in a fully inflated tire, as a hard tire exposes much less surface to the road than a soft tire and also deflects sharp objects that would otherwise penetrate a partly inflated tire. Do not turn corners at high speed as the wear caused by skids shortens the life of the tires. Avoid locking of wheels with brakes as the sliding of the rear tires is most injurious to the casings.

Do not turn in street car tracks and ruts, nor bump the side of the tires into curbs. If oil or grease collects on tires remove as soon as possible. Test tire pressure once a week, and when touring, every morning. Keeping tires at proper pressure will result in easier riding and greater mileage.

ALIGNMENT OF FRONT WHEELS

The greatest cause of wear on front tires is improper alignment of the front wheels. This should be periodically inspected as very often the wheels are thrown out of line by striking curbs or obstructions.

With a long stick measure the distance at the front of the wheels from the inside of one felloe band to the outside of the felloe band on the opposite wheels. Then measure at the rear of the wheel in the same way. The distance between the two should be $\frac{1}{8}$ of an inch greater in the rear than in the front. If the wheels do not toe in this much, correct the alignment by turning the steering knuckle tie rod adjusting yoke.

TO TAKE OFF RIMS

Jack up wheels clear of the road and take off clamp nuts. Remove lock nut and dust cap from valve stem. Turn the wheel so that the valve stem is at the top, then swing out the lower side of the rim and lift rim, with tire, off the wheel.

TO MOUNT SPARE RIM WITH TIRE INFLATED

Turn wheel so that the valve hole in felloe band is at the top. Insert valve stem through hole and swing lower part of the rim snugly into place. Push each clamp into position and turn down each nut to an easy fit. Then continue around the wheel, giving each nut a turn until all nuts seat firmly.

TO TAKE TIRE OFF RIM

Deflate the tire. Take rim off wheel, as explained in a preceding paragraph. With hammer or with hammer and screw driver pry open the lock. Never open lock until tire has been completely deflated.

BATTERY PRECAUTIONS

If the car is kept in an unheated garage or where there is danger of the temperature falling below the freezing point of water, the battery must be kept fully charged to avoid freezing of the electrolyte. The higher the specific gravity of the electrolyte, the lower will be its freezing point. A fully charged battery, with the specific gravity of the electrolyte at 1.285, will not freeze until the temperature drops to 85 degrees Fahrenheit below zero.

To keep your battery in the best condition during the winter months always:

- Enrich the mixture when starting by pulling out the choke;

- Use only engine oil having a low cold test, which will not congeal at the temperature to which it will be subjected;

- Economize on current by using the lights and starter as sparingly as possible;

- Test the specific gravity of the battery every two weeks. Recharge battery at once if the gravity falls to 1.225.

ANTI-SKID DEVICES

For driving in winter or on slippery roads, the use of tire chains is recommended. They may be used with complete satisfaction, if properly adjusted. Always adjust them to creep or crawl around on the tire and change the points at which the chains cross the tire treads. If the chains are too tight, cut or badly worn tire treads will result.

PROPER METHOD OF STORAGE

Remove the tires and store them in a room where they will not be subjected to extremes of temperature. The tires may be wrapped in canvas or paper, after being liberally sprinkled with soapstone. If the tires are not to be removed, block up the car and partially deflate them.

After removing the tires, clean the wheel rims and remove all rust. Coat the surface which comes in contact with the tires with enamel or graphite paint. Flake graphite, mixed with a little shellac, will admirably serve the purpose. Coat all polished metal surfaces with vaseline to prevent tarnishing.

Clean the top and keep it raised. Relieve the tension of the rear hold-down straps so that the fabric will not be stretched. Be sure to drain the cooling system thoroughly and if the car is to remain idle for a month or more, pour a quarter of a pint of heavy lubricating oil in each cylinder through the spark plug hole and turn engine over slowly by hand ten or twelve times.

Either take the battery to a garage for storage, or else have it fully charged prior to storage of car as this will prevent freezing of the electrolyte.

If possible run the engine once a month to bring battery back to a fully charged state, as such charges will not only give better results when the battery is used again, but will also increase its life. Unscrew vent plugs and leave off during this operation. Inspect electrolyte level to make sure that the liquid is $\frac{5}{8}$ of an inch above the tops of the plates. Run engine idle at a speed so that the ammeter will indicate a charge of 10 amperes. Continue charging until all cells "gas" or

bubble freely and the electrolyte has a specific gravity of 1.285 to 1.306.

With the battery in the car, disconnect the wires of the battery during storage, as even a slight leak in the wiring can discharge the battery.

PUTTING THE CAR INTO SERVICE AFTER STORAGE

Carefully go over the entire car. Tighten all nuts, bolts, and screws. Lubricate and grease all points requiring such attention. Drain the oiling system and refill with fresh lubricant. Make sure that the clutch and brakes are properly adjusted. Connect battery wires.

If the car has been standing for a month or longer, a quarter of a pint of lubricating oil should be poured through each spark plug hole before starting the engine; this is not necessary if oil was employed in this way when laying the car up.

Be sure to use hand crank when starting engine for the first time after storage.

CHAPTER FIVE

Trouble Chart

ENGINE WILL NOT START

- Gasolene tank empty.
- Gasolene supply line obstructed.
- Throttle closed.
- Gas mixture too lean.
- Cylinders flooded with gasolene.
- Ignition dead.
- Timer contact points dirty.
- Timer breaker arm stuck open.
- Carburetor frozen owing to water in gasolene.
- Spark plugs dirty.
- Water leaks in cylinder.
- Engine too cold.
- Water on high tension terminal of spark coil.

ENGINE MISSES (at all speeds)

- Faulty spark plugs or cables.
- Battery discharged.
- Battery connections loose or corroded.
- Connections at coil or distributor loose or corroded.

ENGINE MISSES (at low speed only)

- Carburetor improperly adjusted.
- Compression poor.
- Spark plugs dirty or points set too close.
- Air leak between carburetor and engine block.

ENGINE MISSES (at high speed only)

- Carburetor improperly adjusted.
- Intermittent flow of gasolene.
- Spark plug points too far apart.
- Timer breaker arm sticks.